uſurpatis, levamen percepit. Laborat autem iſta obſtructione menſium, quæ mali huhus fons atque origo eſſe videtur.

Wittenbergæ D. 1 *Auguſt.*
A. D. MDCCXXXV.

X. Experiments *concerning the* Vibrations *of* Pendulums. *By the late* W. Derham, *D. D. F. R. S. and Canon of* Windſor.

THE Account which Mr. *Bradley* hath given in *Philoſoph. Tranſact.* N° 432, of Obſervations made at *Jamaica* by Mr. *Campbel,* with a nice *Pendulum-Clock* of Mr. *Graham*'s making, brought to my Mind ſome Experiments I made ſome Years ago, that may be of Uſe in Obſervations of this nature.

The firſt that I ſhall take notice of, ſhall be ſome Experiments I made in the Year 1704, with excellent Inſtruments, concerning the *Vibrations of Pendulums in Vacuo*; which were publiſhed in the *Philoſoph. Tranſact.* N° 294. The Sum of which is, That the Vibrations in *Vacuo* were larger than in the *open Air,* or Receiver unexhauſted: Alſo that the Enlargement or Diminution of the Vibrations, was conſtantly in Proportion to the Quantity of Air, or Rarity, or Denſity thereof, which was left in the Receiver of the Air-Pump. And as the Vibrations were larger or ſhorter, ſo the Times were augmented, or diminiſhed accordingly; *viz.*

two

two Seconds in an Hour ſlower, when the Vibrations were largeſt, and leſs and leſs, as the Air was re-admitted, and the Vibrations ſhortened.

But notwithſtanding the Times were ſlower, as the Vibrations were larger, yet I had Reaſon to conclude, that the Pendulum really moved quicker in *Vacuo*, than in the *Air*, becauſe the ſame Difference, or Enlargement of the Vibrations (as two Tenths of an Inch on a Side) would cauſe the Movement, inſtead of two Seconds in an Hour, to go 6 or 7 Seconds ſlower in the ſame time; as I found by nice Experiments.

The next Experiments I ſhall mention, I made at ſeveral Times, in 1705, 1706, and 1712, by the Help of a good Month-Piece that ſwings Seconds. The Weight that then drove it, was about 12 or 13 Pounds, and it kept Time exactly by the Sun's mean Motion: But by hanging on 6 Pounds more, the Vibrations were enlarged; but yet the Clock gained 13 or 14 Seconds in a Day.

And as the Increaſe or Diminution of the Power that drives the Clock, doth accelerate or retard its Motion, ſo, no doubt, doth *Cleanneſs* or *Foulneſs* affect it, and ſo doth *Heat* and *Cold*; for all have the ſame Effect upon the Pallets and Pendulum.

The laſt Experiments I ſhall mention, I made in 1716 and 1718, to try what Effects *Heat* and *Cold* had upon *Iron Rods* of the ſame Length, or as near as I could to thoſe that ſwing Seconds. I made my Experiments with round Rods of about a Quarter of an Inch Diameter, and with ſquare Rods, of about three Quarters of an Inch Square. The Effects on both which were the ſame.

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At firſt I took the exact Length of the Rods, in their natural Temper. Then I heated them as well as I could in a Smith's Fire, from End to End, nearly to a *Flaming Heat*; by which means, they were lengthened two Tenths of an Inch. Then I *quenched* them in cold Water; which made them $\frac{7}{100}$ of an Inch ſhorter than in their natural State.

Then I warmed them to (as near as I could gueſs) the *Temper* of my Body; by which means they were about $\frac{1}{100}$ of an Inch longer than in their natural Temper.

Afterwards I cooled them in a *ſtrong frigorifick Mixture* of common Salt and Snow, which ſhortened them $\frac{3}{100}$ Parts of an Inch.

Afterwards I meaſured theſe Rods, when heated in an *hot Sun*, which lengthened them $\frac{2}{100}$ Parts of an Inch more than their natural Temper.

All theſe Experiments ſeem to concur in reſolving the Phænomenon of *Pendulum Clocks going ſlower under the Æquator* than in the Latitudes from it: But yet I confeſs, that I have too good an Opinion of Sir *Iſaac Newton*'s Notion of the Sphæroidal *Figure* of the *Earth*, to part eaſily with it; and therefore I leave it to the Conſideration of others, how far the Figure of the Earth, and how far Heat and Cold, and the Rarity and Denſity of the Air, are concerned in that Phænomenon.

XI. *The*